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wherein

Y is the percent, by weight, of silicon,

W is the percent, by weight, of phosphorous.

b is -3 ; and

10. A free-cutting copper alloy, consisting essentially of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum; 0.02 to 0.25 percent, by weight, of phosphorus; at least one element selected from among 0.02 to 0.4 percent, by weight, of chromium and 0.02 to 0.4 percent, by weight, of titanium; and a remaining percentage, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, phosphorous and chromium in the copper alloy satisfy the relationship

wherein

Y is the percent, by weight, of silicon.

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11. A free-cutting copper alloy, consisting essentially of 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; 0.1 to 1.5 percent, by weight, of aluminum; 0.02 to 0.25 percent, by weight, of phosphorus; at least one element selected from among 0.02 to 0.4 percent, by weight, of chromium and 0.02 to 0.4 percent by weight of titanium; one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium and 0.02 to 0.4 percent, by weight, of selenium; and a remaining percentage, by weight, of zinc, wherein the percent by weight of copper, silicon, aluminum, phosphorous and chromium in the copper alloy satisfy the relationship

wherein

60

a is -2,
b is -3, and
c is 2; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one phase selected from the group consisting of a γ phase, a κ phase, and a μ phase.

12. A free-cutting copper alloy which comprises 69 to 79 percent, by weight, of copper; 2.0 to 4.0 percent, by weight, of silicon; 0.02 to 0.4 percent, by weight, of lead; optionally, at least one element selected from among 0.02 to 0.25 percent, by weight, of phosphorus, 0.02 to 0.15 percent, by weight, of antimony, and 0.02 to 0.15 percent, by weight, of arsenic; optionally, one element selected from among 0.02 to 0.4 percent, by weight, of bismuth, 0.02 to 0.4 percent, by weight, of tellurium, and 0.02 to 0.4 percent, by weight, of selenium; and the remaining percent, by weight, of zinc, wherein the percent by weight of copper, silicon and phosphorous in the copper alloy satisfy the relationship

$$60 \leq X - 3Y + aZ \leq 70,$$

wherein

X is the percent, by weight, of copper,

Y is the percent, by weight, of silicon,

Z is the percent, by weight, of phosphorous, and

a is -3; and

the copper alloy has a metal construction comprising multiple phases integrated to form a composite phase, wherein the composite phase is an α phase matrix having a total phase area comprising not more than 5% of a β phase, and 5-70% of the total phase area is provided by at least one